Eumenis semele (L) *thyone* Thompson (Lep. Satyridae). A Microgeographical Race

By R. L. H. Dennis

In a previous paper (antea 82, 1970) it was mentioned that the aspect of size of *E. semele thyone* Th. would be dealt with once representative samples of colonies had been taken in a transect along the North Wales coast. This has now been done.

To recapitulate on the situation, the following was required:—

(1) The average size of the subspecies thyone Th. In my previous paper, it was mentioned that J. A. Thompson had labelled it 47·7 mm. ♂♂, 51·1 mm. ♀♀; whilst E. B. Ford had given 41 mm. ♂♂ and 43 mm. ♀♀,—an obvious discrepancy.

(2) The nature of the cline beyond the Great Orme's Head east to Prestatyn, and west to Anglesey, in an attempt to solve the status of what E. B. Ford termed 'normal specimens.'

Sampling Procedure and Colonies

The accuracy of the results is dependent on the sampling procedures utilized, and two facets are involved.

(i) Total spatial coverage.

The initial step was to demarcate the boundary area of each *semele* colony. These generally followed two patterns. Those colonies at Rhyd-y-Foel, Nant-y-Gamar, Moel Hiraddog, Aber Valley and Bwrdd Arthur, were extremely restricted in areal extension, being limited to precipitous escarpment faces and steep slopes. However, sheep tracks and exposed bedding along rock outcrops, afforded a means of covering each area along the line of the escarpments, and continual transects were taken, steadily covering the vertical face.

The remaining colonies were far more extensive (800×200 yds), but were usually represented by a more horizontal surface. At Prestatyn, Aberffraw and Conway Morfa, the linear pattern of the dunes was followed, and the examples taken accordingly. The Great Orme was divided into 100 subdivisions for each grid square, on a map scale 1:2.500; transects were effected in late June 1970 covering the entire headland, and the detailed distribution of *E. semele* and *P. argus* mapped. It must be borne in mind that Figure 1 is a reduced scale version for this Journal, and as such, a loss in accuracy must be expected. Sampling transects were made along the whole west sector of the Great Orme covering each vertical rise at every arbitrarily noted return point.

(ii) Temporal coverage.

Sampling throughout the flight period was not carried out to the same extent, for the obvious reason of the limited available time. The eleven stations have been sampled over the past three years. It became apparent during the work that the

FIG.I.

size of the *semele* populations varied little from one year to the next in all the inlying stations.

More than twenty sampling days were spent collecting on the Great Orme, and over ten days at colonies between Conway Mountain and Rhyd-y-Foel, with only two days spent at each of the outlying station, where samples were taken during the mid-emergence period of both sexes. The inlying stations were sampled throughout the flight period indicated in Figure 2. The writer could not be in North Wales prior to the 18th June each year, and so *thyone* was not sampled in its early flight

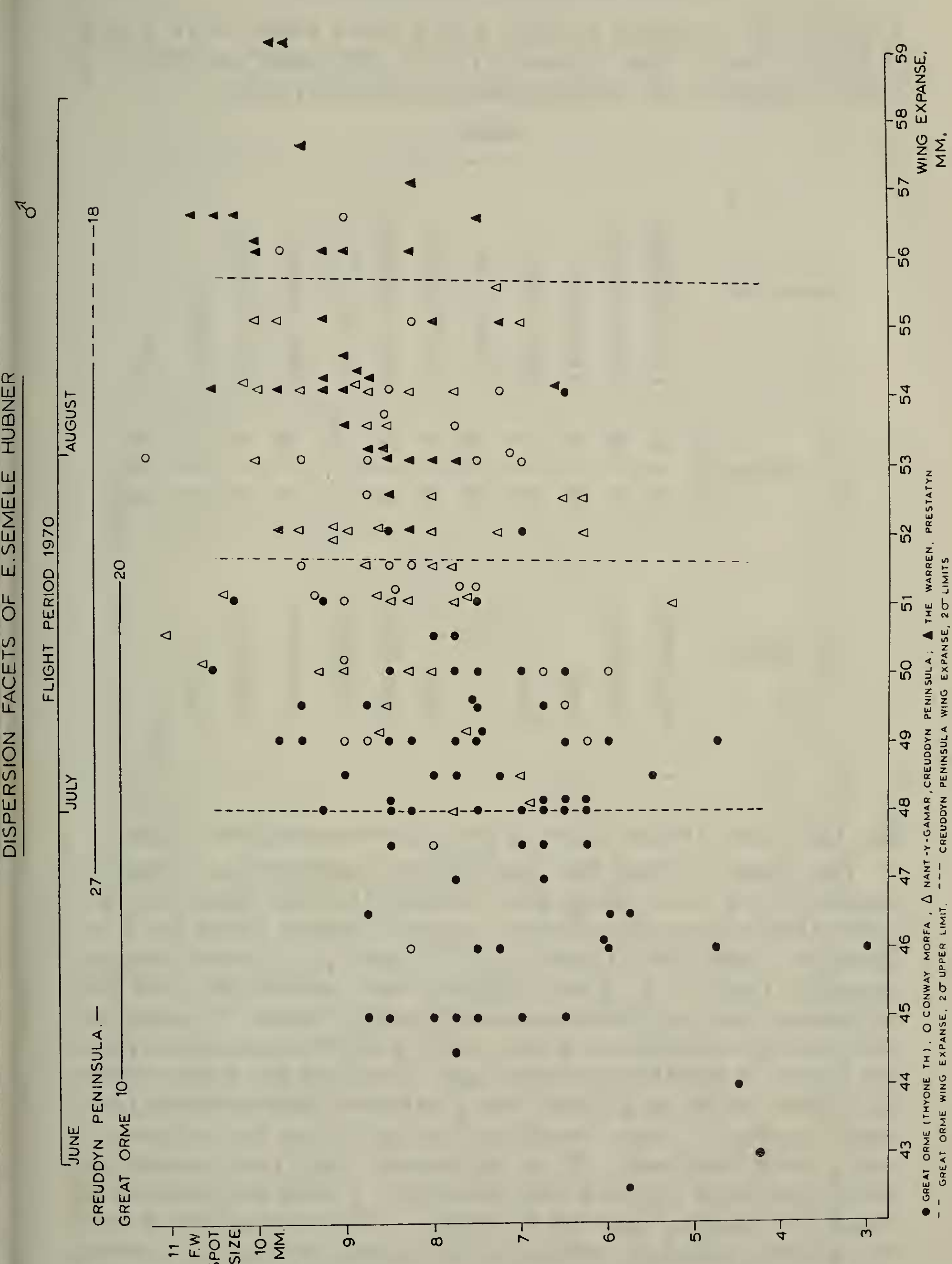


FIG. 2.

period. The date for its emergence is that provided by H. N. Michaelis for 1970.

The final facet of the samples, the actual number of insects utilized, is of course very important. At first, it was assumed necessary to obtain 50 specimens of each sex from each locality, but it was found that stabilisation of the mean began after 15 insects and was attained with a standard error (S.E.) 0·2 to 0·4 mm. at 25-30 specimens. For instance, the Rhyd-y-

Foel ♂♂ of 13 insects in 1970, had a mean value of 51·3 mm. (S.E. 0·57 mm.); with 32 insects (1971), the mean was still 51·3 mm. Details of the sample figures are given below:—

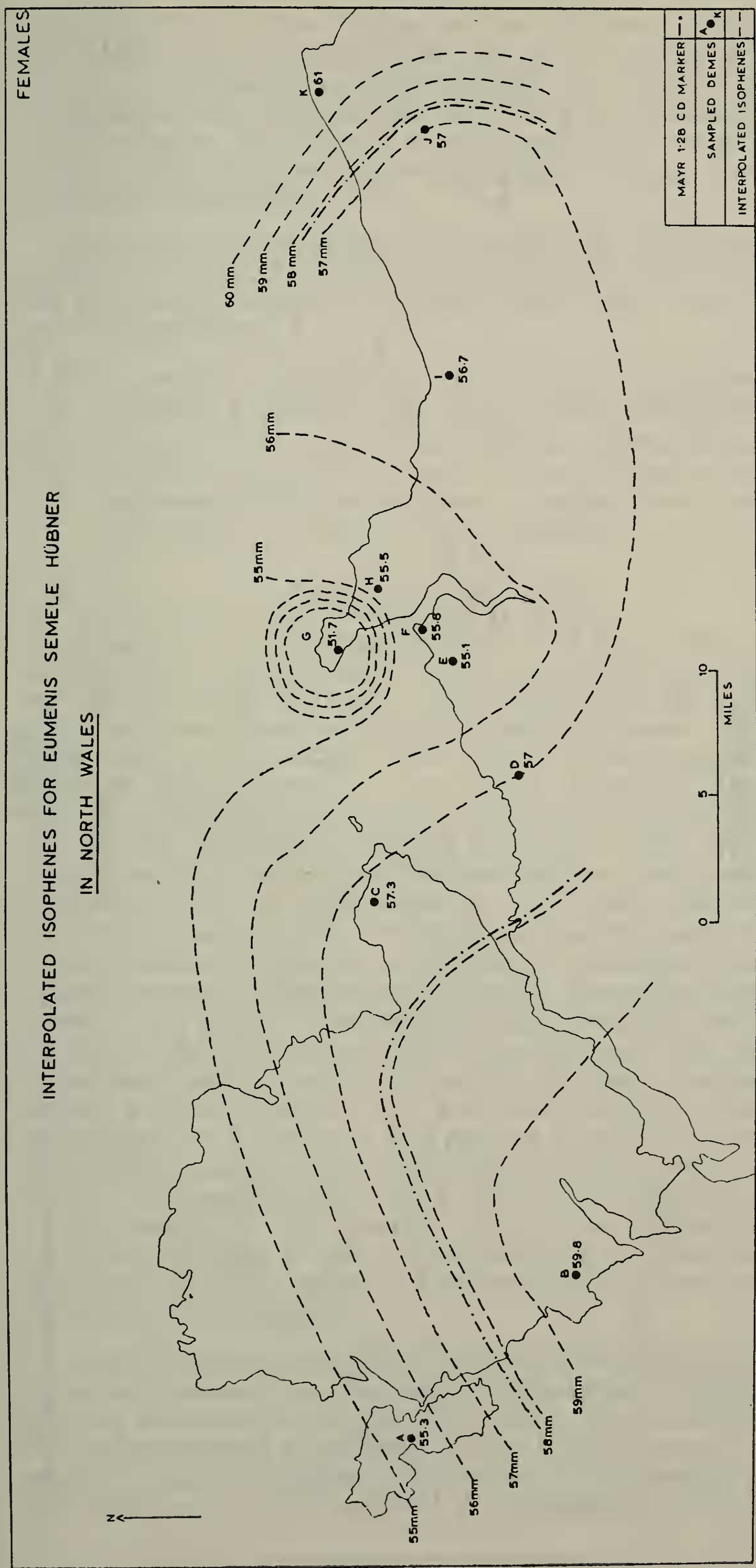
TABLE 1

Localities	Trearddur Bay	Bwrdd Arthur	Aberffraw	Aber Valley	Conway Mt.	Conway Morfa	Nant-y-Gamar	Gt. Orme	Rhyd-y-Foel	Moel Hiraddog	Prestatyn	Total
Samples ♂♂	12	24	55	29	76	31	47	72	32	34	36	448
Samples ♀♀	6	7	25	51	45	22	28	58	17	27	34	320
Lithology	Mica Schist	Limestone	Sand	Slate	Rhyolite	Sand	Limestone	Limestone	Limestone	Limestone	Sand	

The Cline and Delimitation of the Microgeographical Race.

The means of all the populations sampled are given in Figures 3 and 4. It can be seen at once, that the figures for the Great Orme approximate very closely to those given by J. A. Thomson (1944) (48·01 mm ♂♂, 51·7 mm ♀♀). It would appear instantly that E. B. Ford's figures are anomalous, but the difference here is in the manner of measurement. It would appear that G. Thomson and the writer take measurements from the centre of the thorax to the apex, doubling the figure; while E. B. Ford relies on a direct wing expanse measurement from apex to apex. I have certified this by taking measurements using both methods. It is important that the method of measurement is entered with articles). I have G. Thomson to thank for pointing out this dualism. It is preferable to follow the method used here and in G. Thomson's work on *M. jurtina;* as the wing expanse procedure is dependent on the setting whims and ability of the individual.

Isophenes (Figures 3 and 4) have been placed at right angles to the clinal change. It is however, important to bear in mind certain points concerning the isophenes. They have been used here as a discriminate measure between populations, and it is readily noticed that they are correct on the basis of the sampling points entered alone. For instance, on introducing certain sampling points to the south of the Creuddyn Penin-



A. TREARDDUR BAY; B. ABERFFRAW; C. BWRDD ARTHUR; D. ABER VALLEY; E. CONWAY MT, & ALLT WEN; F. CONWAY MORFA; G. GREAT ORME; H. CREUDDYN PENINSULA; I. RHYD-Y-FOEL; J. MÔEL HIRADDOG; K. PRESTATYN SANDS.

FIG.3.

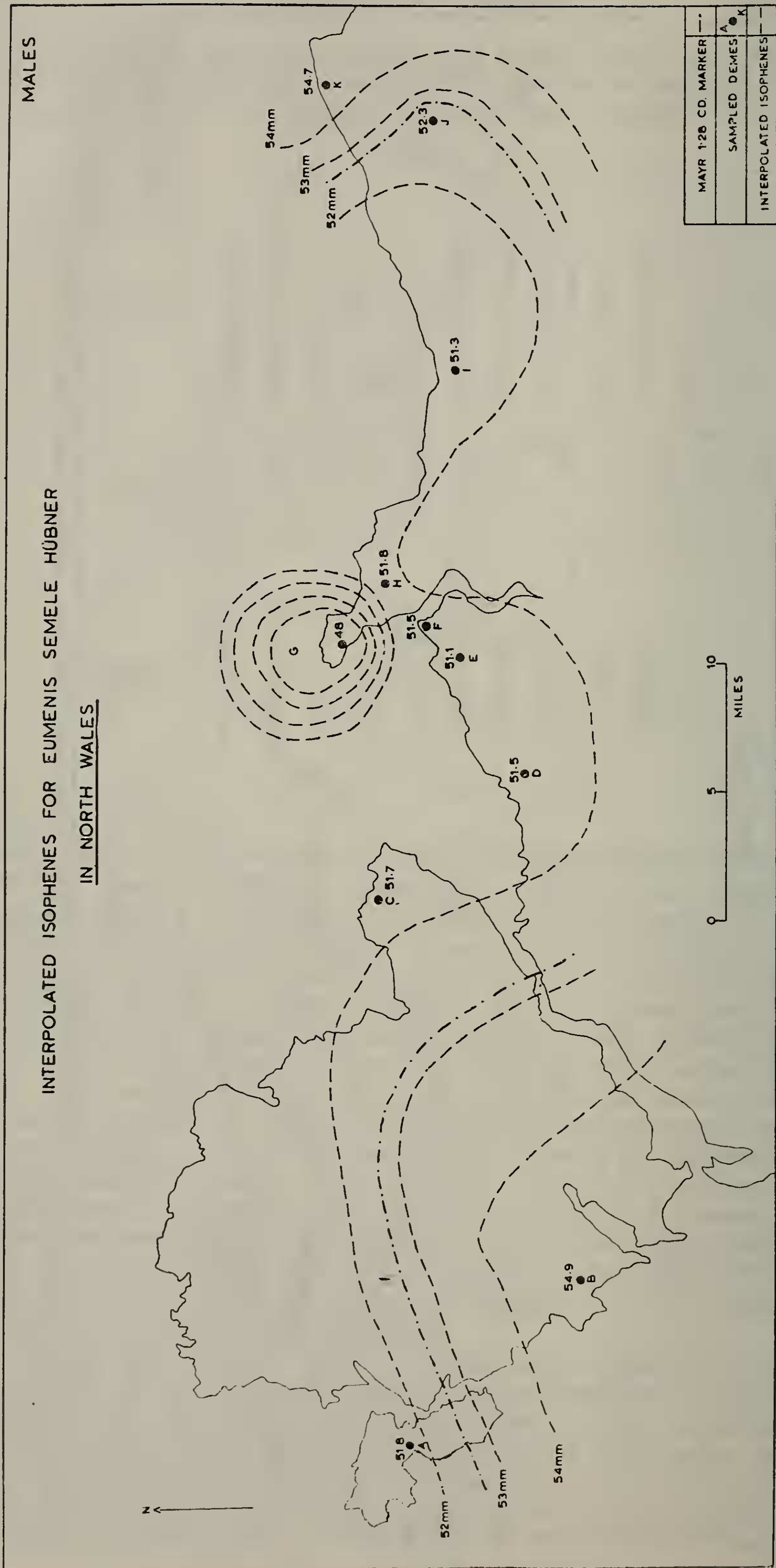

INTERPOLATED ISOPHENES FOR EUMENIS SEMELE HÜBNER
IN NORTH WALES
MALES
MAYR 1·28 CD. MARKER
SAMPLED DEMES
INTERPOLATED ISOPHENES
54mm
53mm
52mm
54.7 K
52.3 J
51.3 I
51.8 H
48 G
51.5 F
51.1 E
51.5 D
51.7 C
54.9 B
51.8 A
0
5
10
MILES
N

FIG. 4.

sula, west of the Aber Valley, and in Anglesey or Flintshire, these lines may well have to be altered. In reality, of course, there is no gradual change between the Great Orme and Nant-y-Gamar (or any other demes), but a sudden break established by Llandudno; in fact it is more correct to assume that no colony exists between presently marked demes, until they have been recorded.

However, the isophenes are valuable in one respect. As a distant measure, they give an appreciable visual impact of the differences between the *semele* populations. Two features are of importance:—

A. The marked clustering of the isophenes at three points indicate a sudden break in the *semele* populations.

B. A wide area of general uniformity representing either gradual change in the semele populations as to size, or a general stabilization about a certain figure oscillating in respect of environmental conditions.

(AI) *The Great Orme thoyne Th. Population*

This break is extremely marked. The great Orme ♂♂ are differentiated from the Nant-y-Gamar ♂♂ ($X^2_{(3)}$ 60·6, $P<0·001$) and the Conway Morfa♂♂ ($X^2_{(3)}$ 118·9, $P<0·001$), the two adjacent populations on a highly significant basis. The difference may appear to be not so great in the females (Great Orme v. Nant-y-Gamar ♀♀ $X^2_{(3)}$ 34·04, $P<0·001$) this being the result of the small numbers used in the Creuddyn sample, but the Chi figure is still highly significant. The area of the subspecies is delimited to the west side of the Great Orme (Figure I), yet the population is not totally isolated from contiguous populations; certain gene flow perhaps increased by anemochore dispersal, implicated by prevailing westerlies, obtains between Conway Morfa *semele*, Llandudno West shore *semele*, and Great Orme *thyone*. It is obvious even in face of population contiguity, soon to be broken, that the limestone-sand dune interface representing the environmental break between *thyone* Th. and the Creuddyn Peninsula populations is a real one, and though perhaps not providing the reason for the racial differentiation is however a basis for it. In more specific terms, it is not an inherent quality of the limestone, nor possibly a major environmental facet of it that provides a selective pressure on the *thyone* population; yet whatever, there is an association of some selective facet with the headland.

It was deemed important to assess the degree of differentiation between the Great Orme population and those contiguous members to it, and those along the whole transect. For this purpose, a corollary of the 75% distance rule was applied, Mayr's coefficient of difference. This statistic relates the difference of the means to a summation of the standard deviations (in this case σ):—

$$CD = \frac{xb - xa}{\sigma a + \sigma b}$$

When the value approaches 1·28, it is a marker of the 75% rule. (According to this, a subspecies is recognised if 75% of the individuals of one population differ from all (97%) of a recognised subspecies, in this case nominotypical semele.) Mayr points out, however, that even values of CD 1·5 are demanded by some authorities for subspecific differentiation.

Using the above relationship, the following was noted:—

Great Orme v. Nant-y-Gamar. ♂♂ CD 1·03
Great Orme v. Nant-y-Gamar. ♀♀ CD 0·82
Great Orme v. Prestatyn. ♂♂ CD 1·8
Great Orme v. Prestatyn. ♀♀ CD 1·9

There is, however, a problem. If size alone is being compared, what wing expanse value represents the normal subspecies, if indeed such exists? It will be seen in a following section that in the south of Britain, the insects are more akin to the size of specimens at Prestatyn, and not as small as those at Moel Hiraddog. There is a strong environmental operative, since similar sized insects as those from the uniform area over most of North Wales (♂♂ 51-52 mm, ♀♀ 55-57 mm) are found in many localities in N.W. England. (Manchester Museum specimens.)

However, deriving for a CD value of 1·28 for the *thyone* population, the nominotypical *semele* would have to be 52·6 mm (1·8σ) ♂♂, and 57·84 mm (2·4σ) ♀♀; at this level, the subspecific category is determined by the 75% marker.

(A2) *The Sand Dune Populations*

It is apparent that the end member populations of the cline are associated with a sand dune environment. Their large size may well be attributed to ecophenotypic variation. Whatever, they differ significantly from adjacent populations:—

Moel Hiraddog v. Prestatyn. ♂♂ $X^2_{(3)}$ 20·12, P<0·001
Bwrdd Arthur v. Aberffraw. ♂♂ $X^2_{(3)}$ 27·23, P<0·001
Moel Hiraddog v. Prestatyn. ♀♀ $X^2_{(3)}$ 29·06, P<0·001

This difference is most likely associated with selection operating towards one end of a continuously variable sequence determined by polygenic factors, for which size is a pleiotropic secondary effect. It is interesting to compare the Conway Morfa figures, which should bearing in mind the environmental relationship approximate the measurement characteristics of Prestatyn and Aberffraw *semele;* that this does not occur, reflects on the clinal situation in the vicinity of the Great Orme, and is an essential feature in determining the subspecific attributes of *thyone* Th.

(B) *The Uniformly Belt of semele along the N. Wales Coast.*

Beyond the Great Orme geotype, and inside the sand dune extremes, uniform *semele* measurements are a remarkable feature (♂♂ 51·1-52·3; ♀♀ 55·1-57·3 mm). The greater range noticed in the females is related to their correspondingly higher standard deviations. The interesting point is that these measurements are associated with five lithological environments. If it assumed that the sand dune *semele* demes are related to environmental pressures producing higher figures, and that outside Conway Morfa the *semele* populations are not affected either by gene flow from the Great Orme, nor under selective pressures approaching those of the Great Orme, then, the uniform type along the N. Wales coast is indifferent to the Great Orme population, and its size characteristics are endemic to the region. It would have an overall mean of ♂♂ 51·6mm and ♀♀ 56·2mm. As then they would represent the environmental equivalent of the nomino-typical *semele* (especially as the majority are on limestone), the Mayr CD. 1·28 marker is too high to endow true subspecific status on E. *semele thyone* Th. However, it and *P. argus caernensis* Th. are microgeographical races .

In view of the above, and in attempt to provide some comparison, the writer was fortunate enough to have access to Manchester Museum semele. Measurements were obtained of *semele* from Winterton (Lincs/Norfolk?), south east localities (Eastbourne, Folkestone), and from the Isle of Man. As only a small number of specimens were available, these measurements can only indicate broad trends. The Winterton (20) and south east *semele* (24) were remarkably homogeneous. (♂♂ 54·8 mm/54·6; ♀♀ 59·8 mm). It was surprising to find such small female figures with the large male measurements, but this could very well be attributed to the small samples available. It is perhaps a certain feature of the south east that *semele* is large, and this is a definite trend on the Continent. The writer has been sent specimens from La Mare, Vendée, and from Champigny, Maine et Loire, that are indicators of this trend; (♂♂ 15, 57·6 mm; ♀♀ 11, 64·1 mm) those from the east Pyrnees are even more extreme, or so it would appear. ♂♂ 6, 60·1 mm; ♀♀ 6, 67·2 mm). It would be very interesting to assess the factors behind these changes, yet, it is not wise to ascribe them to major environmental changes such as alterations in heat, load or insolation without experimental evidence. Finally, it was interesting to find that a short series of ♂♂ semele from the Isle of Man measured 51·6 mm, exactly the N. Wales average given above. These specimens, and others from inland Lancashire corroborated the North Wales uniform type to be unaffected by *thyone* Th. or similar genetic endowments for dwarfed insects.

Spot Size Differences in North Wales E. semele

As this paper is concerned with meristic variation in *E.*

semele, the difference in spot size between *thyone* and other populations can be dealt with here.

J. A. Thompson pointed out in his original description:—
♂♂ "The forewing spots are smaller than in other races, with the lower of the two frequently absent, and totally obsolescent specimens are not very rare". . . . "The tendency to obsolescence is even more striking on the undersurface than on the upperside."
♀♀ "obsolescence is less marked, although the spots are smaller than in normal specimens."

Initially, it must be pointed out that obsolescent specimens have not been seen in the past three years. In fact, of the 73 ♂♂ specimens taken at random, only one displays the absence of a single forewing underside spot. Yet, 1 ♂ and 11 ♀♀ have an extra spot. It seems extremely likely, that at the time J. A. Thompson was collecting, the Great Orme population was extremely abundant, — he describes the butterfly as being in 'immense profusion'—and variable. This variability apparently extended the trend of obsolescence in the forewing spotting. Such periods of variability have been dealt with in detail by Professor E. B. Ford (1964).

It was important to ascertain whether or not J. A. Thompson was correct in his judgement of the reduction of the forewing spots, and to assess the nature of any changes in the population since 1944. It may be stated now, that the only apparent change is that the insect is less abundant—it is common but not in profusion—and less variable.

The two forewing underside and two forewing upperside spots have been measured interneurally for each specimen, and the means of certain populations have been given below:—

TABLE 2

	GT. ORME	NANT.-Y-GAMAR	CONWAY MORFA	PRESTATYN	
♂♂	7·3	8·4	8·2	8·9	mm
♀♀	9·7	11·2	11·4	12·1	mm

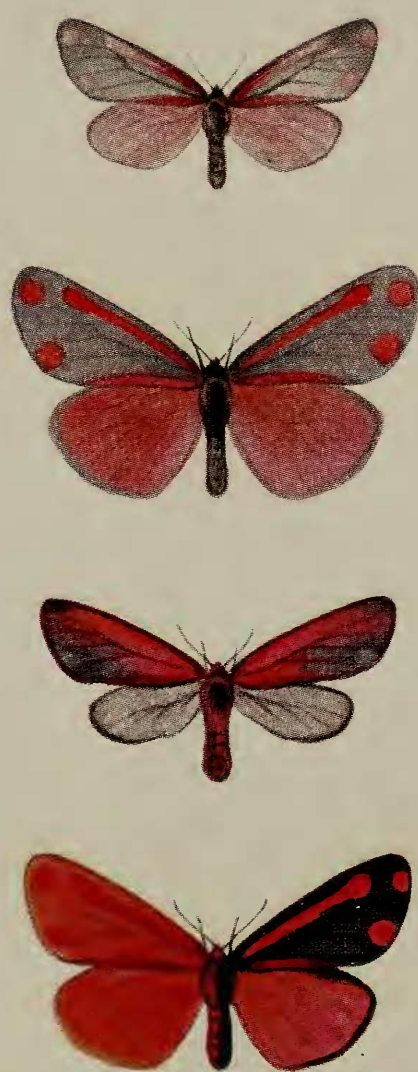
Composite FW. UP. and UN. spots measured interneurally, via proximal—distal attitude.

As the results for each population approximate a gaussian relationship, a t. test was applied, and established the following differences:—

Great Orme v. Nant-y-Gamar. ♂♂ $t\ (117)=4 \cdot 6,\ P<0 \cdot 001$
Great Orme v. Conway Morfa. ♂♂ $t\ (101)=3 \cdot 4,\ P<0 \cdot 001$
Great Orme v. Nant-y-Gamar, ♀♀ $t\ (84)=4 \cdot 3,\ P<0 \cdot 001$
Great Orme v. Conway Morfa. ♀♀ $t\ (78)=5 \cdot 07,\ P<0 \cdot 001$

PLATE I

1
2
3
4



From the original watercolour drawing by A. D. A. Russwurm.

Aberrations of *Callimorpha jacobaeae* L.

1. ab. *transparens* Watson ♂
2. ab. *albescens* Cockayne ♂
3. ab. *inversa* Watson ♀
4. *sinis*. ab. *coneyi* Watson *dex*. typical ♂